AN ESSAY

ON THE VALUE OF

AUSCULTATION AND PERCUSSION,

AND

THE BEST MODE OF PRACTISING THEM:

BEING

THE ESSAY FOR WHICH "THE KING'S COLLEGE MEDICAL AND SCIENTIFIC SOCIETY" AWARDED THEIR FIRST PRIZE IN THE YEAR 1842.

BY

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The following Essay is published at the request of "The King's College Medical and Scientific Society." Although some parts of the subject are more fully treated than was necessary in a dissertation on "the value of Auscultation and Percussion, and the best mode of practising them;" yet this Essay by no means claims to be considered as a complete treatise on Auscultation. The more interesting and important points are discussed at some length, while to others of less importance, comparatively little space has been allotted.

AN ESSAY,

ETC.

The great value of Auscultation and Percussion in facilitating diagnosis, is now so well known and so generally appreciated, that it will be unnecessary for me to do more, than mention the chief advantages, to be derived from these methods of examination. I shall best effect my purpose, by pointing out how uncertain, and how little to be relied upon, were the signs which guided the physician in his diagnosis of thoracic disease, before the discoveries of Avenbrugger and Laennec.

Diseases of the lungs are usually attended by one or more of the following symptoms; pain in the chest, dyspnœa, cough, expectoration, fever. Now, little need be said to establish the fact, that these functional or physiological signs, though sufficiently indicative of disease, or of disorder within the thorax, are, nevertheless, of so vague and uncertain a character as to be quite insufficient, in the generality of cases, to enable us to determine, with any degree of accuracy, the precise nature of the affection which has given rise to them. Thus, in many cases of inflammation of the substance of the lung, pain is very little complained of, and in some cases is altogether absent. Pain, too, is a symptom common to so many affections of the chest, that its value as a diagnostic mark is often very insignificant, and if too much relied upon, would, in many cases, mislead us. How often has rheumatism of the intercostal muscles been mistaken for pleurisy! and how unnecessarily severe has been the treatment adopted in consequence of such a mistake! The character of the expectoration is, in some instances, admitted to be pathognomonic of particular diseases. Thus, there is a peculiarity in the sputa which indicates with considerable certainty that the matter expec-

torated has come from a cavity; and as cavities in the lung are most frequently the result of the evacuation of softened tubercles, we may infer that the patient whose expectoration possesses this character, is labouring under phthisis; but of what value is this sign, occurring, as it does, when the patient is on the brink of the grave? Again, the tenacious rusty sputa when present, is undoubtedly a valuable symptom of pneumonia; but, unfortunately, many cases of pneumonia occur, in which the rusty character of the sputa is entirely absent, and in no cases is it present in the latter stages of the disease. The value of such a sign, then, is this, that when present we may infer the existence of pneumonia, but its absence by no means warrants us in concluding that the disease is not pneumonia.

Enough, I trust, has been said, in proof of the insufficiency of all functional signs for enabling us to arrive at any degree of accuracy in the diagnosis of pulmonary diseases. Such, however, were the signs upon which alone the physician had to rely before the year 1761, when Avenbrugger published his work on Percussion. Notwithstanding the merits of this work, it appears to have excited but little attention at the time, and was imperfectly known until the commencement of the present century, when Corvisart withdrew it from the undeserved oblivion into which it had fallen.

By the introduction of the practice of percussion, one great step was gained towards facilitating and rendering more certain, the diagnosis of thoracic, but more especially, of pulmonary disease. Still, however, much was wanting. As percussion informs us only, by increased or diminished resonance, whether the density of the parts beneath be less or greater than natural, and as increased or diminished density, arises from various causes and different diseases, considerable uncertainty must, in many cases, exist, when this is the only method employed. Fortunately, another great advance was soon to be made; and to Laennec we are indebted for a mode of examination, which, from the accuracy of its results, has rendered our knowledge of the diseases of the lungs and heart more exact, than that of almost any other class of diseases. To Laennec is due the merit, not merely of discovering, but of bringing almost to perfection, the science of Mediate Auscultation; and since the year 1819, when the first edition of his work, *De l'Auscultation Médiate*, was published, comparatively little has been added to our knowledge of the subject.

In the course of this essay, the great value of auscultation and percussion, in enabling us to form a correct diagnosis, will, it is hoped, be clearly shown:—at present I would remark, that these methods of examination, informing us, as they do, of physical changes, and being entirely independent of any information derived from a verbal examination of the patient, are applicable and highly valuable in many instances when, without their aid, we must be content with vague guesses and general suspicions. Thus, inflammatory affections of the chest are very frequent in infants; they run a rapid course, and often terminate fatally; in order to prevent this, early and judicious treatment is required; and it is scarcely necessary to remark, that no treatment can be judicious, which is not founded on a correct diagnosis. A slight degree of experience will be sufficient to convince any one, unaided by auscultation, how difficult is the accurate discrimination of the different diseases of the chest in an infant; and how comparatively easy this is rendered by the practice of auscultation and percussion, will soon be evident to him, who has sufficient perseverance for acquiring the necessary dexterity.

The facility with which we can distinguish the different diseases of the lung, by the aid of auscultation and percussion, being admitted, the *value* of such means of diagnosis will be sufficiently evident, when we consider the great frequency and fatality of pulmonary diseases, especially in our own climate; and that no diseases are more amenable to treatment, than are the generality of those of the lung. But for the latter fact, this mode of examination would merely lead to tiresome and unnecessary refinement, and could not, as it now does, afford an invaluable light to direct us in the choice of our remedies. I shall content myself, for the present, with saying thus much of the *general* value of auscultation and percussion; but I shall occasionally, in the course of my remarks, advert to *particular* instances illustrative of the important assistance, which these methods of examination are calculated to afford us.

I now proceed to speak of the *mode of practising auscultation and percussion.* And first to insist upon the fact, that the practice of auscultation and percussion admits of, and requires, the greatest accuracy and precision; and in order that we may derive from it that benefit, which it is calculated to afford, we must be most *accurate* and *precise* in all our investigations; we must be ready to appreciate every minute variation in the sounds, which it will be

our business to study, and to detect and avoid every source of fallacy; our examinations must not be hurried and careless, but conducted with that due deliberation and cautious regard to details, without which, the information we derive from them will be scanty, vague, and unsatisfactory.

Our first object should be to render ourselves perfectly familiar with the sounds heard on auscultation, and elicited by percussion, in the healthy state; and to learn to what extent, and from what causes, these may be varied, without the existence of disease. It is usual to commence our examination of a patient in whom we suspect thoracic disease, by percussion of the chest; as by this means, we obtain a general notion of the condition of the parts beneath, which is rendered more definite by a subsequent auscultatory examination.

Percussion can be most easily and satisfactorily performed when the chest of the patient is completely uncovered; but there are, in most cases, many obvious objections to such a mode of proceeding, and a thin covering of linen, if made smooth and tense over the part we are about to percuss, offers no serious impediment to the operation. The patient should generally be in the standing or sitting posture, or if recumbent, we must remember that the sound is in some degree deadened by the contiguity of the bed clothes; but this, as we shall presently explain, is of little importance. When percussing the anterior part of the chest, we direct him to sit perfectly erect with his arms to his side; on the contrary, when we are percussing the posterior part, he must lean forwards, with his arms crossed in front; the examination of the axillary region will be facilitated by his raising the arm to his head. The chief point in the position of the patient, is to take care that the two sides of the chest are perfectly symmetrical; for instance, an unequal contraction of the pectoral muscles might, if unobserved, mislead us both in percussion and in auscultation. Having placed the patient in the proper position, we proceed to percuss the chest. The most common method of practising percussion is the following:—the middle finger of the left hand is used as a *pleximeter;* its palmar surface being closely applied to the chest, while the dorsal surface is struck smartly and quickly with two or three fingers of the right hand, the ends of which are to be brought into a line for the purpose. Instead of one finger of the left hand, a *pleximeter* of ivory or wood is occasionally used. There are some advantages attending the use of such an instrument. In the first

place, we are enabled by means of it to elicit a louder sound, especially where there is much œdema or fat; the part struck is more exactly defined, and we may with greater ease determine the precise extent and the limits of the region in which dulness exists. But these trifling advantages in favour of the ivory or wooden pleximeter are, in my opinion, more than counterbalanced by one decided superiority which the finger, used as a pleximeter, has over any inanimate material. This superiority results from the power, which the finger possesses, of appreciating different degrees of elasticity, or of vibrating movement in the parietes of the chest, from which we may acquire important information as to the density of the parts beneath, in addition to that afforded by the mere dulness or resonance on percussion: and hence it is, that the existence of solidification of the lung, is often much more evident to the person who is percussing, than to a by-stander, who can judge merely from the sound elicited by the blow. Some persons, instead of percussing with the ends of the fingers, use a hammer for the purpose, the surface of the hammer being covered with leather or caoutchouc: when this instrument is used for percussion, the ivory pleximeter must necessarily be employed. By means of the hammer we may rapidly percuss the entire chest, and easily define the exact degree and extent of dulness. The result of percussion by this instrument too, may be made sufficiently evident to almost any number of by-standers. But percussion by a hammer has a somewhat formidable appearance to a person suffering from disease, and I have more than once heard bitter complaints of the pain and increase of suffering resulting from such a proceeding. After some experience of all these methods, I give the preference to the simplest, *viz.* that which consists in using one finger of the left hand as a pleximeter, and the extremities of two or three fingers of the right for the purpose of percussion.

In percussing the chest we are determined in our estimate of the result, not so much by any absolute degree of dulness, as by a comparison of the relative degree of resonance or dulness, in exactly corresponding points on opposite sides of the chest. We must, therefore, take due care that all the conditions on the two sides are similar. We must strike on corresponding points on the two sides, and with equal force; the pleximeter finger must be placed in the same direction, (generally across the ribs,) and it must be pressed on the chest with equal firmness: the more firmly the finger is pressed against the chest, the greater will be the

resonance with the same force of percussion. In doubtful cases, it may be necessary to attend to the *period* of the respiratory act. Thus, if we direct a person with healthy lungs to make a deep inspiration, and percuss the chest when fully expanded, comparing the resonance with the duller sound elicited by percussion after a forced or even an ordinary expiration, we shall at once perceive the difference to be so considerable, that it might, in some cases, prove a source of error.

As a general rule, we expect to find an equal degree of resonance in corresponding points of the two sides of the chest; but to this there are a few exceptions arising from the presence of certain viscera. Thus we find on the left side of the chest a space of about two inches square, its centre being between the fifth and sixth ribs, in which a dulness on percussion indicates the situation of the heart; if the dull space be not greater than this, it is perfectly natural; a greater extent of dulness would lead us to suspect either enlargement of the heart or an accumulation of liquid in the pericardium. Again, on the right side, dulness on percussion over the false ribs, is the result merely of the presence of the liver in that situation. The resonance over the space corresponding to the left false ribs, varies according as the stomach is distended by gas, or by the more solid materials of a hearty meal; this region is generally somewhat tympanitic. Thus we have three spaces corresponding to the situation of the heart, liver, and stomach, over which the resonance of corresponding points of the two sides of the chest, is, in the natural and healthy condition of the parts, unsymmetrical. Over the remaining portions of the chest, there is naturally a perfect symmetry in the resonance of the two sides. There is, however, a considerable difference in the resonance of various parts of the same side of the chest, which, with the exceptions above mentioned, results from the different degrees of thickness of the muscular, and other natural coverings.

As a general rule, then, a difference in the degree of resonance in corresponding situations on the two sides of the chest would lead to the suspicion of disease, not necessarily on the dull side; for in cases of *emphysema*, and *pneumo-thorax*, the diseased side is the one which is most resonant. If, on the other hand, there be no perceptible difference in the resonance on percussion of the two sides, we conclude that the parts beneath are free from disease, at least, from such disease as changes the density of the lung. In *bronchitis*, however, we get no information from percussion,

the density of the lung not being increased by that disease; or if it be, both lungs are almost invariably affected at the same time, and in equal degree, so that the relative resonance undergoes no change. It rarely happens that a disease, whose tendency is to solidify the pulmonary tissue, affects both lungs simultaneously, and to the same extent. Thus, for example, although a tubercular deposit in one lung is commonly accompanied by a deposit of the same kind in the other lung, yet the disease is almost invariably more extensive and farther advanced on the one side than on the other.

By percussion of the chest, then, we learn whether the lungs occupy their usual position, and contain the normal quantity of air, or whether they have become condensed by a tubercular deposit or by the process of inflammation; whether they have been compressed and replaced by a liquid effusion into the pleura, or have been pushed aside by an enlarged heart or by a distended pericardium. For the most part, we can by percussion ascertain only that the density of the parts beneath is increased or diminished, the cause of this increase or diminution of density remaining to be determined by other evidence. In a few cases, however, percussion affords us information of a more definite kind. Thus, we may often infer the presence of liquid in the pleura, from the *great degree* of dulness, and from its limit being very exactly defined; also from the gradual manner in which, in the course of a few hours, the dulness extends from the lower to the upper part of the chest, and from its level varying with a change in the position of the patient. We may often be assured that distension of the pericardium with liquid, is the cause of dulness on percussion, by observing that the dull space corresponds exactly with the form and limits of the pericardium, being conical, with the apex of the cone in the direction of the ascending aorta.

Percussion is often of great assistance in enabling us to ascertain the condition of the parts within the abdomen. Thus, the size of the liver, or of the spleen when enlarged, may often be accurately determined by this means; also the condition of the bladder, as to fulness or the contrary; and the state of the large intestines, whether distended with gas or loaded with fæces. The size of the gravid uterus may be readily ascertained, by contrasting the dulness over its surface with the resonance over the large intestines which surround it.

The presence of liquid in the cavity of the peritonæum may be

easily ascertained, and its limits defined, by percussion over the part. Percussion, too, affords important assistance in the diagnosis of ascites and ovarian dropsy. In ascites the intestines float in the liquid, and, if the latter be not very abundant, the former come in contact with the abdominal parietes; consequently, when the patient is lying on his back, the umbilical region is the only part of the abdomen which is resonant on percussion. In ovarian dropsy, on the contrary, the tumor pushes aside the intestines and occupies the front of the abdomen, the umbilical region yielding a dull sound on percussion, while the lateral parts of the abdomen are resonant.

I have now to speak of *the practice of auscultation*, confining my remarks, at present, to auscultation of the Lungs. The sounds of respiration and of the voice may be heard in two ways; by applying the ear to the surface of the chest, or by means of the *stethoscope*, which is used for conducting the sounds from the surface of the chest to the ear of the auscultator; the first method is called *immediate*, the second *mediate* auscultation. There can, I imagine, be little doubt, that the preference should, in most cases, be given to mediate auscultation. The only advantage of immediate auscultation, consists in the greater facility and distinctness, with which we can hear the sounds of respiration when the ear is directly applied to the chest. Opposed to this advantage, which is in itself inconsiderable, are the following serious disadvantages:—When we apply the ear immediately to the surface of the chest, we hear not merely those sounds which originate in the portion of lung directly under our ear, but the sound is conducted through the bones of the head and face, from all that part of the chest with which these are in contact. Hence, it is impossible to ascertain, with precision, the situation and extent of any sound heard in this manner. Again, the phenomena of the voice can be explored much less satisfactorily by immediate auscultation, than by mediate; if one mode of distinguishing pectoriloquy from bronchophony, be by attending to the fact, that the sound of the former appears to permeate the tube of the stethoscope and enter the ear of the auscultator, while that of the latter seems to be conducted no farther than the surface of the chest, this distinction must evidently be lost to one who does not practise mediate auscultation. The same difficulty exists in ascertaining, by immediate auscultation, the extent of the heart's sounds, and the degree of its impulse. Again, the practice of immediate auscultation is

inconvenient, and even impossible in some parts of the chest, in the axillary region, for instance; in one case the sex of the patient might render the practice of it indelicate, while in another a want of cleanliness would constitute a serious objection to it. It is evident, then, that the advantages attending the practice of mediate auscultation, are both numerous and important. Hence, there appears good ground for the assertion, that immediate auscultation should be adopted only in those rare cases, in which the feeble character of a sound renders its existence or its nature doubtful. If, on the contrary, we have recourse to the stethoscope only in those cases, in which we are compelled to employ it, we shall not acquire that perfect skill and confidence in its use, which can only be obtained by constant practice.

In applying the stethoscope we must be careful to keep it in close apposition with the surface of the chest, and with our own ear; the former may be accomplished in an emaciated subject, by placing some lint or linen in the intercostal spaces, so as to render the surface level. The position of the patient I have already spoken of; that of the auscultator must be easy and unrestrained, much bending of the neck should be avoided as tending to produce congestion of the brain, which is a condition most unfavourable to delicacy in the sense of hearing.

In auscultation of the lungs, two distinct sets of phenomena present themselves for examination, *viz.* those of respiration, and those of the voice. Our first aim must be, to render ourselves familiar with the natural sounds of respiration, with their varieties in character and in intensity, in the child and in the adult, and even in different persons of the same age; with the influence of a forced and hurried inspiration upon the intensity of the respiratory murmur; and with the different characters of the respiratory sounds in various parts of the chest. We must also acquaint ourselves with that indistinct vocal resonance, which is heard over a healthy chest, and which is somewhat more distinct over the large bronchi at the roots of the lungs: its modification according to the nature and pitch of the voice, also deserves attention.

In auscultation of the lungs a comparison of corresponding points of the two sides of the chest, is less important than in the practice of percussion; it is only when examining the *intensity* of the respiratory murmur, or the *degree* of the vocal resonance, that such a comparison is required; most of the sounds observed on auscultation having characters sufficiently definite to render

unnecessary any reference to the natural sounds, for the purpose of establishing the fact of their being abnormal; this abnormal character consisting, not in increased or diminished intensity, but in certain absolute and distinctive peculiarities.

Having made ourselves familiar with the sounds observed on auscultation of the healthy lung, we are prepared to appreciate those deviations from the natural sounds which indicate the existence of disease. It is not my intention to describe minutely the various modifications in the sounds of respiration and of the voice, which result from disease; but rather to direct attention to some points connected with auscultation of the lungs, rendered unusually interesting from their difficulty. I shall thus be better enabled to point out the *best mode of practising auscultation*, in other words, to indicate that method by which we may hope to ascertain the truth, and avoid error.

The difficulties most commonly met with in auscultation of the lungs, are of two kinds; first, to distinguish one sound from another, to which it bears a certain resemblance; and, secondly, after ascertaining the nature of a sound, to determine its cause, or the condition of the lung which gives rise to it; for, as we shall find, the same auscultatory phenomena do not of necessity, and upon all occasions, indicate the same disease.

Those modifications of the respiratory sounds which are liable to be confounded, are the natural respiratory murmur, especially when loud or puerile, with bronchial respiration; and small crepitation, with large. The vocal sounds which are liable to be mistaken are bronchophony, for either pectoriloquy, or ægophony.

And first, of the difficulty of distinguishing the natural respiratory murmur from bronchial respiration; the distinction is one which it is, of course, highly important to make, since the one sound originates in a healthy lung, while the other is the consequence of an extensive alteration in the consistence and structure of the organ. The character of the sound alone will in many cases be insufficient for enabling the inexperienced auscultator to distinguish bronchial breathing from the natural respiratory murmur, because the two sounds run into each other by insensible gradations; but if we attend to one circumstance, we shall, in most cases, be able to determine with the greatest certainty, whether we are listening to bronchial breathing or the natural sound of respiration. The respiratory murmur, and puerile respiration, which latter differs from the former only in intensity, are heard chiefly

during *inspiration*, and are scarcely audible during *expiration;* bronchial breathing, on the contrary, is loud and prolonged during expiration, and is often heard during expiration only, the inspiratory sound being at the same time vesicular, though perhaps louder and rougher than natural; when the sound attending both the entrance and the exit of the air is bronchial, we generally observe that the expiratory sound is loudest and has the tubular character most strongly marked. This is an excellent distinctive mark between bronchial breathing, and the sound of the natural or puerile respiration.

Can we explain the characters which I have just now mentioned as belonging to bronchial breathing? The passage of the air through the bronchial tubes must, constantly and of necessity, produce a certain sound; but all those sounds which originate in the deep portions of a healthy lung, are diminished and lost, before reaching the surface, by the repeated reflexions, to which they are subjected during their passage through the various media of which the tissue of the lung is made up. Hence, those sounds which we hear proceeding from a healthy lung, are such as result from the entrance of air into the cells near the surface of the organ, while, on account of the small conducting power of the pulmonary tissue, those sounds which are produced in the deep-seated air-cells and bronchi, are perfectly inaudible. If the lung become solidified and rendered more homogeneous by the obliteration of the air-cells, as occurs in pneumonia, the bronchial tubes remaining pervious, the sound resulting from the passage of the air through the tubes in the condensed portion of the lung, will be conducted to the surface, and we shall hear bronchial respiration. I would suggest the following explanation of the fact, that the sound of expiration has often the bronchial character, when that of inspiration has not, and that, when both inspiration and expiration are bronchial, the latter is almost invariably louder and more characteristic. If we trace a bronchial tube from its commencement in the lung, to its termination in the trachea, we find it at first of small size, it is then joined by other tubes, and gradually dilates, until its diameter becomes very considerable: thus, a bronchial tube may be represented as trumpet-shaped, the base of the trumpet being directed towards the trachea. If we take a tube of this form, (the ordinary stethoscope will answer the purpose,) and, covering the large end with the lips, blow into it with moderate force, we produce a certain whispering sound; if we then reverse the instrument, and blow

with the same degree of force into the small end, we shall produce a blowing, tubular sound, considerably louder, and of a somewhat different pitch. The sounds thus produced, have an exact resemblance to bronchial respiration, not merely in their character, but in their mode of production: thus during inspiration the air is blown from the large to the small end of the tubes, and during expiration it is impelled in the opposite direction, from the small to the large end; in fact, much in the same manner as we blow when sounding a trumpet. We cannot, perhaps, strictly consider one bronchial tube as being continuous from the pulmonary vesicles to the trachea, but for the present purpose there is, I conceive, nothing incorrect in the supposition that it is so. If, then, the sound of inspiration in any case, be vesicular, and that of expiration bronchial, we may infer, that the portion of lung over which these sounds are heard, is not sufficiently solid and homogeneous to conduct to the surface the feebler sound produced by the passage of the air from the large to the small ends of the bronchial tubes, but the louder sound resulting from its passage in the opposite direction, is conducted and rendered audible; when a portion of the lung has become more completely solid, both inspiration and expiration assume the bronchial character. This is well exemplified in the progress of an ordinary case of pneumonia; when a portion of lung is completely hepatised, we hear distinct bronchial inspiration, as well as bronchial expiration; but when the inflammation is subsiding, and some of the vesicles readmit air, the lung being rendered a less perfect conductor, the bronchial inspiration is replaced by vesicular breathing with the *crepitatio redux*, while the sound of expiration continues distinctly bronchial, in some cases, for several days.

There is another phenomenon, which may be explained by referring to the trumpet shape of the bronchial tubes, and to the effect of blowing in opposite directions through such tubes; I allude to the prolonged and loud expiratory sound, which is so commonly heard when there is a moderate tubercular deposit in the upper lobe of one or of both lungs. The explanation of this which is usually given, is, that the deposit lessens the elasticity of the lung; the lung consequently collapses more slowly, and as the act of expiration is prolonged, the sound of expiration must necessarily be so too. There are several considerations, which appear to me to concur in rendering this explanation unsatisfactory. Doubtless, the resiliency of the lung is an important agent

in expiration, but, certainly, a much less *powerful* one than the elasticity of the costal cartilages and the action of the abdominal muscles; and the mere diminution or loss of this resiliency could scarcely prolong the *act* of expiration to an equal extent with the lengthened *sound* of expiration, which is frequently heard in cases of incipient phthisis. Especially must this loss or diminution of resiliency be considered inadequate to account for the prolonged expiratory sound, if we remember that it is often heard when the tubercular deposit occupies only a small portion of the lung, and that this portion must be forced to collapse, if it collapse at all, simultaneously with the remaining portion of the lung, by the resiliency of that portion, as well as by the elasticity of the costal cartilages, and by the contraction of the abdominal muscles. But even admitting the diminution of resiliency to be a sufficient explanation of the slow collapse of the lung, still this would not account for the fact, that the sound of expiration in these cases, is not only prolonged, but louder than natural, and, what is still more remarkable, that it is frequently louder than the sound of inspiration in the same portion of the lung; since it is evident that a slow and prolonged collapse of the lung must be a less forcible one, and in proportion as the air is propelled with less velocity, the sound produced by it will be, *cæteris paribus*, less intense; consequently, the sound produced during expiration in these cases, though prolonged, should be more feeble, than that accompanying inspiration. It appears to me that this prolonged expiratory sound, admits of the same explanation as that which has been given of the loud and prolonged bronchial expiration; in fact, that the cause of the former is merely a less degree of the same condition of the lung, as that which produces bronchial breathing.

In cases of phthisis, when the prolonged expiration is heard, the inspiratory sound is usually vesicular, but rough and mixed with a slight crepitation; the expiratory sound being prolonged, louder than the inspiratory, and frequently attended by a slight puff, as if from the passage of air through minute tubes, but not having the decided bronchial character. Such a modification of the respiratory sounds, results from a tubercular deposit having partially solidified the lung around some of the smaller tubes near the surface; consequently, the sound produced by the passage of air through these tubes, is conducted to the ear of the auscultator: the sound of inspiration is composed of that arising from the entrance of air into those vesicles, which have not yet been

obliterated by the tubercular deposit, and the slight sound consequent on its passage through the small superficial tubes, in a direction from their large to their smaller extremities; whilst the prolonged, louder, and more blowing sound of expiration, is generated by the passage of the air from the small to the larger ends of the trumpet-shaped tubes. As the disease progresses, a more abundant tubercular deposit occurs, and the lung is more completely solidified, so that the sounds originating in the large and deep-seated bronchi become audible, and we hear bronchial breathing and bronchophony.

The effect of blowing from a confined to a more open space, is, again, exemplified in the loud cavernous breathing, produced by the passage of air from a bronchial tube into a cavity in the lung, and again, in the still louder *amphoric* resonance, which is produced by the blowing of air from the lung into the cavity of the pleura. The sound in all the cases which we have mentioned, appears to result from the vibrations communicated to the dilated end of a tube, or to the walls of a cavity, by the sudden expansion of a current of air, after it has been compressed in its passage through a confined and narrow space. It would, perhaps, be carrying this analogy too far, if we were to extend it to natural respiration, and, by means of it, to account for the predominance, in length and intensity, of the sound of inspiration over that of expiration. We may, however, hazard the conjecture, that the sound of inspiration is produced in the same manner as that of cavernous breathing, by the passage of air from a tube into a cavity; the cavities in which the former originates, *viz.* the pulmonary vesicles, differing from those which give rise to the latter, only in their great number, and in their extreme minuteness: during expiration, the air passes from these small cavities into the extremities of the minute bronchial tubes in an almost inaudible manner.*

I have said that there may be a difficulty in distinguishing *small* crepitation from *large*; not that there can be any danger of mis-

* It must be remembered, that the parts in which I have supposed the natural respiratory murmur to originate, viz., the vesicles and the smallest tubes, are rendered completely impervious to air, when, from a solidification of the lung, bronchial breathing becomes audible; so that there is nothing contradictory in explaining by the same theory the fact, that in the case of the *natural* respiratory murmur, inspiration is loudest and most prolonged, whilst in *bronchial* breathing the sound of expiration predominates; these two apparently contradictory phenomena tend rather to confirm the explanation which I have given of them.

taking a well-marked case of small, for one of large crepitation; but it frequently happens, that we hear a sound as it were intermediate between them, and a doubt may arise as to its nature. In the first stage of pneumonia, the fine crepitation is always distinct, and not to be mistaken; but the *crepitatio redux*, which occurs when the hepatisation is going off, and the secretion is becoming less viscid, is of a looser character, and verges towards large crepitation. In addition to the different characters of the sounds, there is another important method of distinguishing small crepitation from large; and this is by attention to the fact, that small crepitation has its origin in the pulmonary vesicles, and, consequently, that it replaces the respiratory murmur; whereas, by care and attention, we may generally in a case of large crepitation, hear the respiratory murmur in the same part of the lung, in which the crepitation is heard: the only difficulty in distinguishing the sounds, arises from the feeble character of the respiratory murmur, compared with that of large crepitation. It may sometimes happen that the lung is inflamed, and that fine crepitation exists, but is rendered inaudible by the louder sound of a large crepitation consequent on bronchitis; it must of necessity be difficult under such circumstances, to detect pneumonia in its early stage by the auscultatory signs alone; but we may console ourselves with the consideration, that, although pneumonia is almost invariably accompanied with some degree of bronchitis, yet it rarely happens that the former supervenes upon the latter.

Pectoriloquy, bronchophony, and ægophony, like most of the sounds heard on auscultation, are sufficiently distinct, and recognised easily enough when well marked; but it may be, and, indeed, often is, no easy matter to determine whether the term pectoriloquy or bronchophony should be made use of to designate the vocal resonance; and in other cases the question arises, is it ægophony or bronchophony to which we are listening? Pectoriloquy is the term applied to the sound of the voice, heard proceeding, as it were, from the patient's chest, and traversing the tube of the stethoscope. In order that pectoriloquy may be *perfect*, the cavity must be of moderate size, nearly empty, having a ready communication with one or more bronchi, be near the surface, and be surrounded by condensed lungs; under such circumstances the voice appears to pass up the stethoscope, into the ear of the auscultator, the resonance is circumscribed, and the respiration in the same spot is cavernous; if the cavity contain much liquid, the

resonance of the voice is less perfect, and the respiration is less distinctly cavernous, a deep inspiration or a cough being attended with a gurgling sound, while the expiration is blowing; the latter phenomenon arising, as I believe, not from the mere passage of the air out of the cavity, but from its transit along the bronchial tubes in the condensed lung surrounding the cavity; for the same reason, when pectoriloquy is perfect, we frequently hear a short whiff accompanying each sound articulated slowly and distinctly; this, of course, results from a small quantity of air being puffed from the cavity by each short expiratory effort, which is necessary for the production of an articulate sound. Pectoriloquy is said to be indistinct, when several bronchi enter the cavity, and when the cavity is of large size; it may cease entirely for a time, in consequence of the tube or tubes, which enter it, becoming obstructed by a viscid secretion.

Bronchophony is heard in the same cases, and results from the same condition of the lung, as that which gives rise to bronchial breathing; but as the sound of the voice is much louder than that of respiration, bronchophony may often be heard before the lung has become sufficiently solid to render bronchial breathing audible, and, for the same reason, the former frequently continues to be distinctly audible for some time after the latter has ceased to be so. We have frequent opportunities of observing both these facts during the progress of a case of pneumonia. Bronchophony differs from pectoriloquy, in appearing to stop at the surface of the chest; the sound does not so decidedly pass up the tube of the stethoscope; it is not circumscribed, but is frequently heard over a large portion of one or of both lungs; but the two sounds merge into each other by imperceptible degrees, so that, in many cases, it is impossible to say which name is applicable; and the two sounds are not unfrequently combined; thus, bronchophony may result from solidification of the lung round a cavity, which gives rise to distinct pectoriloquy.

Ægophony may be said to be bronchophony modified by the passage of the sound through a stratum of liquid. The modification thus acquired consists in a peculiar vibratory, or reedy, character; the voice being at one time like an echo, at another like the bleat of a goat, whence its name, or like the voice of *Punch*. The distinctness of ægophony depends on the natural pitch of the patient's voice, the sound being more characteristic when the pitch is high, than when it is low. Ægophony is heard only near the

surface of the liquid; below this the bronchial tubes are compressed, and neither the respiration nor the voice is distinctly audible; hence the situation in which the sound is best heard will vary with the posture of the patient, and the consequent change in the level of the liquid. The sound disappears entirely when the liquid effusion is very great, so that the presence of ægophony may be considered, in a certain sense, a favourable sign in pleurisy. The situation in which ægophony is usually most distinct, is about the inferior angle of the scapula; "and if an ægophonous patient lies on his belly, not only does the ægophony disappear from the inter-scapular region, but it is replaced by a bronchophony of greater or less intensity, according as the lung is sound or in a state of inflammation." By attention to the various circumstances I have mentioned, we shall seldom have much difficulty in distinguishing ægophony from bronchophony.

After having percussed the chest, and examined it by auscultation, the results of the former method are to be compared with, and corrected by those of the latter; and, in addition, we must seek for all the assistance to be derived from an examination into the history and progress of the disease, as well as from a consideration of the general or constitutional symptoms, and of the character of the expectoration. Such a general review of all the circumstances connected with a case is frequently necessary before we can correctly interpret the physical signs revealed to us by auscultation and percussion.

I have hitherto spoken of certain sounds, chiefly with reference to the difficulty of distinguishing them from others to which they bear a certain resemblance. I shall now briefly consider these sounds, as well as some others, chiefly with the view of ascertaining the condition of the lung or pleura which they severally indicate.

Small crepitation is, in the great majority of cases in which it is heard, a pretty certain sign of the existence of pneumonia. Strictly speaking, it indicates nothing more than the presence of a small quantity of liquid in the air-cells of the lung — a condition which may arise not only from inflammation of the lung, but from œdema, or from an effusion of blood into the vesicles. In order, then, to ascertain what condition of the lung has given rise to the small crepitation, the attendant circumstances must be considered. Pneumonia will be attended by inflammatory fever, by more or less local pain or uneasiness, in most cases by the peculiar viscid and rusty sputa, and the small crepitation will soon be replaced by bronchial breathing. If œdema of the lung be the

cause of small crepitation, those symptoms which I have spoken of as attending pneumonia, will be absent; there will probably be dropsy in other parts of the body, perhaps with evidence of obstructed circulation through the heart; the fine crepitation will frequently persist, without any change, for a considerable period. If the presence of blood in the air-cells be the cause of the crepitation, we should be led to suspect this by the existence of some condition of the lungs, or of the heart, which is known to favour the effusion of blood: such as tubercles in the former, or valvular disease of the latter; and still more convincing evidence would be derived from the occurrence of hæmoptysis.

Bronchial breathing indicates nothing more than solidification of the pulmonary tissue: the cause of this solidification, whether a deposit of tubercles, or hepatisation, or the presence of liquid in the pleura, must be determined by the place of the sounds, by the attendant symptoms, and by the history and progress of the disease.

Pectoriloquy is pretty certain evidence of a cavity in the lung; and in the great majority of instances such a cavity results from the evacuation of softened tubercles; but, in rare cases, the separation of a gangrenous eschar, or the formation and evacuation of an abscess, or a dilated bronchus, may give rise to the same phenomenon. Except the last, the history and concomitant symptoms would be sufficient to determine the nature of the case. It is often a matter of the greatest difficulty to distinguish a dilated bronchus containing a puriform secretion, from a cavity produced by the evacuation of tubercles. In the latter case we expect to find a greater dulness on percussion, the pectoriloquy more circumscribed and perfect, and we may sometimes ascertain that the cavity is extending more rapidly, than the dilatation of a bronchus would probably do. Again, if there be merely dilated bronchi, we do not expect those severe constitutional symptoms, the emaciation, hectic, and diarrhœa, which occur in the advanced stages of phthisis; but, in some cases all these symptoms occur, the character of the expectoration will not assist us, and, unless we have had an opportunity of watching the case from its commencement, it is sometimes impossible to ascertain whether the patient has phthisis, or chronic bronchitis with dilated bronchi.

Amphoric resonance and *metallic tinkling*, occur under two circumstances. First, when a large cavity exists in the lung, containing a small quantity of liquid pus. Secondly, when there is pneumothorax, and a bronchus communicates freely with the cavity of the pleura. We may ascertain to which of these two conditions the

phenomena are due by attention to the following points:—When perforation of the pleura occurs there is a sudden accession of pain and urgent dyspnœa; there is great resonance on percussion, especially at the upper part of the chest, and total absence of the respiratory murmur in the same situation, the only sound of respiration being the amphoric resonance; at the lower part of the chest percussion produces a dull sound, from the presence of liquid in that situation. When a large tuberculous cavity gives rise to the amphoric resonance, the dulness on percussion is greatest at the upper part of the chest, where the deposit of tubercles is always most abundant, while, over the base of the lung, which is comparatively healthy, a clearer sound is elicited by percussion, and some respiration may be heard mixed with crepitation. The diagnosis of these cases is sometimes rendered difficult by the existence of adhesions between the pulmonary and costal pleuræ, which prevent the collapse of the lung after the occurrence of perforation: in such a case there will be dulness on percussion beneath the clavicles, and it will scarcely be possible to distinguish pneumothorax from a large cavity in the lung.

A friction sound is sometimes heard attending the movements of respiration; it results from a roughening of the opposed surfaces of the pleuræ by effused lymph; it is a pretty certain sign of an inflamed pleura, and it farther indicates that the liquid effusion is not abundant; it is sometimes heard in the early stage of pleurisy, but most commonly after the liquid has become absorbed, and before the pulmonary and costal pleuræ adhere; it generally ceases to be audible after a few days, but occasionally the surfaces of the pleuræ become permanently roughened without the formation of adhesions, and the friction sound continues for an indefinite period.

Rhonchus and *Sibilus* are sounds originating in the bronchial tubes, which, when heard extensively over the lower part of both lungs, are valuable signs of the first stage of bronchitis; they are sometimes heard over the upper lobe of one or both lungs in the early stage of phthisis, when the irritation of tubercles is exciting a circumscribed inflammation of the bronchial mucous membrane. In acute bronchitis, the rhonchus and sibilus are soon succeeded by large crepitation; the latter sound, then, is indicative of a more advanced stage of the disease.

The careful study of a few cases of phthisis cannot fail of being in the highest degree instructive to one who is anxious to become familiar with the physical signs of pulmonary disease, the pheno-

mena which occur during the progress of such cases being both numerous and varied. The first physical sign which we can perceive in a case of phthisis, and it is one which occurs very early, is a slight crackling beneath one clavicle, sometimes heard only after a deep inspiration or a cough; it results from an increased secretion produced by the irritation of tubercles. The secretion continues to increase in quantity, and a rhonchus and sibilus may occasionally be heard, these sounds frequently ceasing for a time after an effort of coughing, which expels the accumulated secretion. At this time there is, perhaps, some dulness on percussion beneath one clavicle, the expiration being prolonged with some increased vocal resonance. The dulness on percussion increases, the breathing and voice become distinctly bronchial; in many cases the tubercles near the surface excite some inflammation of the pleura, which is occasionally indicated by a friction sound; or a circumscribed inflammation of the lung may be excited, and be revealed by the occurrence of small crepitation. At length the tubercles become softened and evacuated, leaving cavities which give rise to cavernous breathing, gurgling, and pectoriloquy. Again, if these cavities increase to a large size, or if perforation of the lung occur, we may hear amphoric resonance and metallic tinkling; so that there are few auscultatory signs, which may not develop themselves during the progress of a case of phthisis, and the brief survey which I have taken of these signs as they do occur in such cases, will be sufficient to show that, by the aid of auscultation and percussion, we can not merely ascertain the fact, that a patient is labouring under a particular disease, but we are farther enabled to determine the extent of lung affected, as well as the stage of the disease, and the complication of one form of disease with another. It is scarcely necessary to add, that this is much more than any can hope to accomplish who trust to functional signs alone, disregarding the aid which auscultation and percussion afford.

After having, by the aid of auscultation and percussion, satisfied ourselves of the nature of a disease, and of the changes which it has produced in the structure of the lung, we must carefully study the history and progress of the case, in order to ascertain the cause of the malady, and its effect on the constitution; such an inquiry being absolutely necessary for enabling us to conduct the treatment on rational and scientific principles. The existence of rhonchus and sibilus, or of large crepitation, is sufficient evidence that the patient has bronchitis; but before we decide upon our remedies, and

before we prognosticate benefit from them, we must endeavour to ascertain whether this be a simple inflammation, or whether it depend on the presence of some noxious agent in the blood. Again, the physical signs of pneumonia may be sufficiently evident, but before we order a large bleeding, and tartar emetic, we must carefully examine the constitution of the patient. If he be young and well nourished this treatment will, perhaps, be the best, but if he be old, feeble, or anæmic, it may be necessary to give stimulants, and certainly to refrain from any violently-depressing remedies. The value of auscultation and percussion, then, in the diagnosis of pulmonary disease, consists in the great facilities they afford for the accurate distinction of the physical changes induced by the various morbid processes to which the lungs are liable: our guidance for prognosis and treatment must, as I have before said, be derived from other sources.

I shall now speak of auscultation and percussion in the diagnosis of diseases of the Heart and Pericardium.

Before we commence the study of the sounds heard on auscultation of the heart, it is necessary for us to acquire an accurate knowledge of the position of the heart and of the great blood-vessels. I may mention some of the most important facts.

The position of the heart is oblique from above downwards, and from right to left; the anterior surface is formed chiefly by the right cavities, the posterior by the left; the apex, which is formed by the left ventricle, beats between the fifth and sixth left ribs, at a point about two inches below the nipple, and one inch on its sternal side. A line drawn from the inferior margin of the third ribs across the sternum passes over the pulmonic valves, a little to the left of the medial line, and those of the aorta are behind them, but about half an inch lower down: from this point the aorta and pulmonary artery ascend; the former inclines slightly to the right, coming in contact with the sternum when it emerges from beneath the pulmonary artery, and, in forming its arch, it nearly reaches the right edge of the sternum. The pulmonary artery, which at first lies most superficial, and in contact with the sternum, inclines to the left, and divides between the cartilages of the second and third ribs, and close to the left edge of the sternum into the right and left pulmonary artery. The auriculo-ventricular orifices are situated in the space between the third and fourth ribs. The pericardium ascends on the great vessels as high as the commencement of the transverse portion of the arch of the aorta.

I stated in a previous part of this essay, that over the healthy heart there is a space of about two inches, which yields a dull sound on percussion. There are two circumstances, which may prevent this dulness on percussion: these are, *first*, an emphysematous condition of the lung, in consequence of which the lung intervenes between the heart and the anterior wall of the chest; and, *secondly*, the chicken-breasted form of chest, which is commonly resonant over the cardiac region, the heart retaining its usual position, while the ribs bulge forwards. If the dulness in the cardiac region be more extensive than natural, in consequence of increased development of the muscular structure of the heart, we may ascertain whether this belongs more to the right or the left ventricle, by observing the direction in which the dulness extends. If the pericardium be distended with liquid, we can trace the dulness, which extends in a conical form, sometimes as high as the second rib.

In listening to the healthy heart it is necessary to direct attention to the following phenomena:—*first*, the degree of impulse, as felt by the lifting of the head when applied to the stethoscope placed over the apex. *Secondly*, the sounds: their character; the first sound being dull and prolonged, the second sharp and flapping; and their rhythm; dividing the time occupied by one beat of the heart into fourths, the first sound occupies two-fourths, the second one-fourth, there is then an interval of one-fourth, to which again succeeds the first sound.

Another circumstance requiring attention, is the cause of the heart's sounds, and the situation in which they are best heard. The first sound, which accompanies the systole of the ventricle is said to result from the following causes: the muscular *bruit* consequent on the contraction of the ventricles, the tension of the mitral and tricuspid valves, the sudden tension of the muscular fibre itself, especially when the ventricle is thin, and contracts rapidly, and lastly, the impulse of the apex against the walls of the chest. The cause of the second sound is much more simple, being the sudden tension of the aortic and pulmonary valves during the diastole of the ventricles, the blood being driven against the valves by the sudden reaction of the vessels upon their contents. The first sound is best heard at the apex of the heart, the second is loudest between the cartilages of the third and fourth left ribs. The right ventricle is felt and heard at the bottom of the sternum; the left, at the point where the apex beats. The sound of the aortic and pulmonary valves cannot be distinguished from each

other, except by tracing them along the course of their respective arteries: thus we may hear the flapping of the aortic valves along the arch of the aorta, and even over the subclavian. The sound of the pulmonary valves is more feeble, the reaction of the pulmonary artery being much less than that of the aorta, and we can seldom distinguish the sound of these valves from that of the aortic. We should seek for it at the termination of the pulmonary artery, between the second and third ribs. These are the chief points with which an acquaintance is necessary before we can be prepared to study those phenomena which result from disease of the heart, or of its investing membrane.

The principal organic affections of the heart which are made known to us by auscultation, are hypertrophy of the muscular substance, dilatation of the cavities, valvular diseases, and roughening of the pericardium, generally the result of inflammation, and the effusion of lymph. We detect hypertrophy by the prolonged heaving and powerful impulse, the ventricle appearing to touch the chest, first, by a single point, then by its whole surface, afterwards suddenly receding with a quick back stroke; the first sound is feeble and heard over a small space. Dilatation of the ventricles produces a short and feeble impulse, the first sound is sharp and quick like the second, and heard over an extensive space. In both hypertrophy and dilatation, as the right or the left ventricle is affected, the phenomena will be more distinct under the end of the sternum, or between the fifth and sixth left ribs.

The sounds that result from disease of the valves, are generally recognised with facility, and it is by no means difficult to ascertain which valves are affected in any case, when the disease is sufficiently extensive to impair their functions in a material degree. A bellows, or sawing sound, may originate in the orifices through which the blood passes, either during the onward passage of the blood from some resistance to its free progress, or by its passing in a retrograde course, on account of an imperfection in the valves, which prevents the perfect closure of the orifice; in the majority of cases a bellows sound is produced by a regurgitation of the blood, and not by its passage onwards in the course of the circulation. The aortic valves, when diseased, frequently become puckered and shortened so as to be insufficient for the perfect closure of the orifice; occasionally, too, one of them becomes partially detached from the vessel, by a sudden rupture, or by a process of ulceration; in either case we shall have a diastolic

bellows sound, the production of which may be thus accounted for: suppose one of the semi-lunar valves partially separated from the artery; immediately after the systole, and during the diastole of the ventricle, the artery reacts upon its contents; the two sound valves are thrown down and rendered tense by the pressure of the blood, whilst a current rushes past their edges into the ventricle, through the orifice left by the rupture of the third valve; the two tense valves are thus thrown into vibrations by the current against their edges, precisely in the same manner as a piece of glass is made to vibrate when we hold it in the centre, between the finger and thumb, and draw across its edge the bow of a violin; the vibrations of the valves are communicated to the walls of the artery, and in this way is produced a sound of a blowing or sawing character. Imperfection of the aortic valves, then, is indicated by a diastolic* bellows sound, which is best heard over the base of the heart, between the cartilages of the third and fourth left ribs, and is distinctly audible along the course of the aorta. It sometimes happens that a thickened state of the aortic valves offers some resistance to the passage of the blood from the ventricle into the artery, in consequence of which a systolic sound originates in the aortic orifice which is heard in the same situation as the diastolic sound.

A systolic sound in the aortic orifice is generally softer and more feeble than a diastolic one, the valves in the former case being evidently in a state much less favourable for vibration than when their condition is such as to admit of regurgitation and a consequent diastolic sound. If there be at the same time both obstructive and regurgitant disease of the aortic valves, there will be a double bellows sound, one sound attending the systole, and another the diastole. The aortic valves are frequently thickened, but give rise to no bellows sound, either systolic or diastolic; yet we may be often led to suspect this thickening, by observing that the second sound has a dull, indistinct character, instead of the clear, sharp sound which arises from the sudden tension of the healthy valves.

A bellows sound, originating either in the mitral or tricuspid orifice, is almost invariably systolic; and results from the regurgi-

* If there should be any difficulty in ascertaining whether a sound be systolic or diastolic, we shall be much assisted by placing the finger on the pulse at the same time that we are listening to the heart; a systolic sound is synchronous with the pulse, while a diastolic sound immediately follows the pulse.

tation of the blood into the auricle during the contraction of the ventricle. During the diastole, when the blood is flowing from the auricles into the ventricles, the mitral and tricuspid valves are lax, the cordæ tendiniæ being loose, and they are evidently in an unfavourable state for receiving and communicating vibrations; but, if the edges of the valves become thickened so as to prevent their coming into exact apposition, the blood, during the systole, is driven forcibly through the orifice thus left, and in its passage it impinges on the tense edges of the valves, and, throwing them into vibrations, produces a bellows sound.

The sound produced by regurgitation through the mitral or tricuspid orifice, is generally soft and blowing, whereas that arising from regurgitation through the aortic orifice, is in most cases loud, and sometimes musical. We may explain this difference, if we consider that the regurgitant current impinges at right angles on the edges of the aortic valves, this being much more favourable for producing rapid vibrations than the obliquely-directed current which flows against the edges of the mitral and tricuspid valves. Again, the margins of the mitral and tricuspid valves are bound down, and their vibrations limited by the attachment of the cordæ tendiniæ; the aortic valves, on the contrary, have their margins free, and are at the same time more tense than the others; it seems probable, too, that any sound originating in the mitral or tricuspid orifice will be diminished by being surrounded, as it is, by muscular fibre, which acts as a sort of damper, and must certainly be a more imperfect conductor than the tense walls of the aorta. We sometimes, however, hear a very loud sound produced by regurgitation of the blood through the mitral orifice; and, in such cases, we find that the valves have become much thickened and rigid, the two divisions forming a sort of spout which projects into the ventricles, and the margins of which are evidently well adapted for receiving vibrations.

We rarely, perhaps never, hear *a diastolic* sound originating in the mitral or tricuspid orifice; the reason of this, in addition to what has already been said of the condition of the valves, is, that the blood is driven into the ventricles with but a slight degree of force by the feeble contraction of the auricles; and any slight sound which is produced in this manner can scarcely be audible, since it occurs during the diastole, when the heart is not in contact with the chest, and, consequently, when there is no continuous conductor to the surface of the chest. A systolic sound arising in the mitral orifice, is best heard at the apex of the heart, whereas a

similar sound originating in the tricuspid orifice, is loudest at the bottom of the sternum. Valvular diseases are much more common on the left side of the heart than on the right; we occasionally see disease of the tricuspid valves, but the pulmonary are scarcely ever found changed in structure.

A bellows sound does not necessarily indicate organic disease of the heart; since a soft sound is sometimes heard over the aorta, in persons who have lost large quantities of blood, or in cases of anæmia from imperfect assimilation. Under the same circumstances the *bruit de diable* is heard in the veins at the root of the neck; and the fact of the two sounds being combined, would sufficiently display the true nature of the bellows sound.

The *to-and-fro* sound, produced by friction of the surfaces of the pericardium when roughened by lymph, is generally recognised with facility: it might sometimes be confounded with a bellows sound, originating in one of the orifices; but it is much more superficial, and has less of a blowing character than of a rubbing, and sometimes it is a creaking sound.

What then is the value of auscultation and percussion in cardiac disease?

The to-and-fro sound is a simple and certain sign of pericarditis, whether idiopathic or rheumatic; and the systolic bellows sound in the latter cases indicates that the endocardium has become affected, and thus warns us to adopt active measures at the only period when valvular disease is under control.

By percussion in pericarditis we can ascertain the amount of liquid poured out, and thus explain the distressing symptoms which occur when the effusion is very great; by the same means, too, we are enabled to trace the gradual absorption of the liquid. It is important in some cases of fever to ascertain the force of the heart's impulse, and the intensity of the sounds; we are sometimes guided in the use of stimuli by the information thus acquired. We cannot repair an imperfect valve, and hence it may be said, it is of no importance to be able to detect such an imperfection; but by ascertaining the existence of valvular disease we may often understand, and consequently treat more rationally, a dropsy, a bronchitis, or a congestion of the brain; and thus, although we cannot remove the primary evil, we may palliate and perhaps remove some of its distressing consequences. But the power of forming a correct diagnosis must not be depreciated because our treatment is not thereby immediately improved; it may be useful even to know that our treatment can be of no avail, as it may save the patient

from the empirical and rash administration of medicines from which mischief might result. In cases of valvular disease our *prognosis* will be more certainly correct, if by auscultation we ascertain the degree of hypertrophy of the ventricle, since we know that, *cæteris paribus*, life will be prolonged in proportion as the hypertrophy is greater. Lastly, auscultation of the heart is frequently valuable from its enabling us to determine the absence of disease, and thus to remove from the mind of our patient a source of considerable anxiety.

If we apply the stethoscope over a large artery, we hear a short sound at each ventricular contraction, the sound being much increased, and assuming a blowing character when the instrument is made to press moderately on the vessel. The inner surface of the aorta frequently becomes roughened and sometimes quite ossific, in consequence of deposits between the middle and inner coats: this condition of the vessel is indicated by a loud and superficial bellows sound along the course of the arch; that this sound does not arise from disease of the valves may be ascertained by observing that the sound of the valves which immediately follows the bellows sound, has the usual clear and distinct character. If an artery become aneurismal, a short blowing sound may be heard over the tumor at each contraction of the ventricle, and in some cases a second sound may be heard when the sac reacts upon its contents, and expels a portion of the blood again into the artery: this, then, is a valuable sign of aneurism, and will serve to distinguish such a tumor from others for which it might otherwise be mistaken. By percussion and auscultation we may frequently detect a thoracic aneurism before any tumor is visible, and thus we may account for a number of symptoms, which, without the aid of these means would be considered anomalous and inexplicable. The aneurismal nature of a tumor in the orbit has been detected by auscultation over the frontal bone, and the cure of the disease has been the result of the treatment, which this accurate means of diagnosis rendered justifiable.

A word on auscultation as applied to the detection of pregnancy. There are two sounds not uncommonly heard over the gravid uterus. One sound is that of the fœtal heart: it is a double sound resembling the tic-tac of a watch beneath a pillow; it varies in frequency from 120 to 160 in a minute. The woman should lie on her back, with the shoulders raised and the legs drawn up, to relax, as much as possible, the abdominal parietes: the stethoscope must be firmly pressed against the most prominent part of the

uterine tumor, so as to displace any intestine, or liquor amnii, which may intervene between the back of the child and the wall of the abdomen. This sound is not audible before the fifth month of pregnancy; when present it is a certain sign, not only of pregnancy, but of the life of the child: on account of the difficulty of hearing it in some cases, we must not infer from its absence, either the non-existence of pregnancy, or the death of the child. Another sound is the placental or uterine soufflet, which differs from the last in being synchronous with the maternal pulse. The same kind of sound may be produced by the pressure of a tumor on the iliac veins, or even, it is said, from pressure on the epigrastic and other veins in the abdominal wall; so that this is a more uncertain sign than the last. The situation of the placental soufflet will sometimes assist us in ascertaining whether the placenta be attached near the os-uteri—a point which the accoucheur is often most anxious to ascertain.

The surgeon seldom avails himself of the assistance of auscultation, but he may occasionally do so with advantage. It is often difficult to assure ourselves of the presence or absence of a fracture of the rib, and the examination with the fingers is invariably very painful to the patient. Such a fracture may generally be detected with the greatest facility by means of the stethoscope, slight pressure being made over the seat of injury while the patient is inspiring. The same method may occasionally be employed with advantage to detect fracture of other bones which are covered by a great thickness of muscle; thus a fracture of the upper part of the fibula may often be easily recognised in this manner, when a painful manual examination would be much less satisfactory both to patient and practitioner.

THE END.

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